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Measuring Excessive Risk-Taking in Banking*

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Abstract
In this paper we propose a new approach to the assessment of excessive risk-taking by a banking sector. We use the portfolio approach to assess the optimal risk-return combination of a bank's portfolio, based on data for 32 categories of loans. It provides a benchmark for the optimality of the bank's portfolio. We apply this method on an exhaustive sample of Czech banks for the period January 2005–February 2008. We observe an average excess of risk-taking of 33% of the optimal risk and a slight reduction of this excess risk over the analyzed period.

1. Introduction

The current financial crisis reminds us of the importance of financial stability for economic development. In their investigation of banking crises, Hoggarth, Reis, and Saporta (2002) notably found that output falls by 15–20% on average during banking crisis periods. A key element in financial stability is the excessive risk-taking behavior of banks. It is therefore of prime interest to measure their excessive risk-taking.

However, an analysis of the empirical literature reveals some limitations in such measurement. These stem from difficulties in obtaining detailed data on banking activities and also in aggregating them. Riess et al. (2002) compare the mobilized funds and the lent funds of banks in transition countries to assess the risk-taking behavior of banks in loan activity. Many empirical studies use the ratio of non-performing loans to total loans to measure this behavior (e.g. Berger and De Young, 1997; Podpiera and Weill, 2008; and Podpiera and Pruteanu-Podpiera, 2008). Such measures suffer from the fact that they only consider aggregate loan activity and they usually reflect cyclical economic development. Furthermore, they do not provide normative information by giving recommendations on possible improvements in the risk-taking behavior of banks (Bekö and Festić, 2008).

The aim of this paper is to provide a new measure of excessive risk-taking which addresses the structural more than the cyclical nature of risk-taking and allows the assessment of excessive risk-taking by a banking industry without aggregating all categories of loans.[1] This is a new approach also in comparison to the former work of researchers at the Czech National Bank, which focused on the determinants of bad loans and bank failures – Podpiera and Weill (2008) and Podpiera and Pruteanu-

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[1] Of course we only consider the risks associated with the lending activity of banks with our approach, as is also the case for the non-performing loan ratio.

-Podpiera (2008). Those articles studied the role of management (approximated by a cost efficiency measure) in the accumulation of bad loans and bank failures respectively.

Our measure is based on the application of the portfolio approach (Markowitz, 1952). This approach has been widely used, but to the best of our knowledge it has not been applied so far to assess the risk-return combination of a bank's portfolio. We first compute the risk and return for each category of loans at the country level (i.e., aggregated across all banks). Then the portfolio approach enables us to estimate the average bank's optimal portfolio, which is defined as the combination of categories of loans that would produce the least risk for a given return. Excessive risk--taking behavior is therefore the risk-return score obtained by the ratio of the optimal risk to the effective risk of the average bank's portfolio for a given return. Thus, we have a measure of excessive risk-taking behavior which evolves over time and we compute it for each month. This normative measure provides information about how much a banking industry can still reduce its risk while preserving the same return.

We provide an application of the measure of excessive risk-taking on the Czech banking industry. We use an exhaustive dataset for all banks and branches of foreign banks operating in the Czech banking market covering monthly data from January 2005 to February 2008. We consider 32 categories of loans in the computation of the efficient bank portfolio. This application provides information on two key issues for the Czech banking industry. On the one hand, it informs us about the optimality of the risk-taking behavior of Czech banks and consequently provides information on the potential risks to financial stability. It is therefore a tool of utmost interest for financial stability analysts. On the other hand, it allows the assessment of the evolution of the risk-taking behavior of Czech banks during that period. It then yields information on the improvement or deterioration of the risk-taking behavior during the recent period.

The structure of the paper is as follows. Section 2 describes the methodology of the portfolio approach. Section 3 describes the data and the evolution of Czech banks' portfolio. The empirical results are presented in Section 4. Finally, in Section 5 we provide some concluding remarks.

2. Methodology

The novelty of our approach lies in the adoption of the well-established methodology of the optimal portfolio approach for the banking sector, with the aim to assess the excessive risk-taking behavior of banks. Our measure of excessive risk--taking is thus based on the assessment of the risk-return combination of a banking sector's loan portfolio.

The banks' portfolio consists of several categories of loans, which are all described by a return and a risk. We first compute the risk and the return for all categories of loans at the aggregate banking sector level. We then use the portfolio approach to estimate the efficient frontier, i.e., the combinations of shares of loan categories that produce the least risk for a given return. Comparing the actual outcome to the efficient frontier, we obtain a measure of excessive risk-taking for the Czech banking sector in each month.

In the first step, we compute the share of each category of loans in the total loans of the entire banking sector in every month. The share α_{it} for a category i ($i = 1,\ldots, 32$) for month t is thus given by:

$$\alpha_{it} = \frac{loans\ i\ for\ month\ t}{total\ loans\ for\ month\ t} \tag{1}$$

In the second step, we compute the return and the risk of the portfolio of the banking sector.

For each category of loans, the monthly return is represented by a weighted average interest rate (not the entire annual average percentage costs for a loan), and the weights represent the relative share of loans in each bank. The risk is measured as the standard deviation of the monthly returns in each category of loans for the full period of the study. Regarding the definition of risk, we assume that the interest rate charged entails *ex ante* risk compensation (based on clients' overall creditworthiness). Thus, a relatively higher interest rate is usually applied to categories of loans that are non-collateralized or with lower requirements as regards clients' ability to repay. At the same time, in such categories the differentiation between clients is likely to be substantially greater. Therefore, the observed differences in the time variation in interest rates across categories of loans are actually a proxy for measuring differences in their riskiness. In our approach we do not distinguish whether the riskiness comes from differences in maturity or differences in creditworthiness. In contrast to the classical measure of risk, i.e., the share of non-performing loans, which measures the *ex post* realized risk, our measure is oriented toward *ex ante* risk assessment.

The overall return of the portfolio is readily obtained by weighting each loan category's return by the relative importance of that category in the portfolio of the banking sector. Accordingly, the return for month t, which we denote as G_t, is given by:

$$G_t = \sum_{i=1}^{32} \alpha_{it} \cdot g_{it} \tag{2}$$

where g_{it} is category i's return for a given month t.

Further, the risk of the portfolio of the banking sector is given by the standard deviation of the return of the portfolio according to the following formula:

$$stde_t = \sqrt{\sum_{i=1}^{32}\sum_{k=1}^{32} \alpha_{it}\alpha_{kt}\omega_{ik}} \tag{3}$$

In the above expression, ω_{ik} denotes the covariance of loan category i's return with loan category k's, and whenever $i = k$ it simply denotes the variance of loan category i's return. In our computations of the covariance matrix, we assume a steady distribution of returns within each category of loans over the analyzed period and thus we keep it time-invariant.[2] Given that the analyzed period is relatively short, this is a reasonable assumption.

The final step of our analysis is to assess the excessive risk-taking of the banking sector. To do so, we determine the set of efficient portfolios for the banking sector, which is defined as the combination of categories of loans that would produce the least risk for a certain interval of portfolio returns $G_j \in \{G_L, G_H\}$ (see also Copeland and Weston, 1988, for an exposition of the determination of efficient portfolios). In formal terms, this can be represented by

$$Min_{\{\alpha_i^*\}} stdo_{G_j} = \sqrt{\sum_{i=1}^{32}\sum_{k=1}^{32} \alpha_i^* \alpha_k^* \omega_{ik}}$$

such that

$$\sum_{i=1}^{32} \alpha_i^* \cdot g_i = G_j$$

for all $G_j \in \{G_L, G_H\}$ and for all i it holds that $\alpha_i^* \in \{\alpha_{i,L}, \alpha_{i,H}\}$ where g_i represents the sample average of the return of loan category i.

In the computation of the efficient frontier, we impose a lower bound for the share in each loan category. The minimum share ($\alpha_{i,L}$) and maximum share ($\alpha_{i,H}$) of each loan category i correspond to the monthly minimum and maximum attained in our sample by a single bank in each respective category of loans (see *Table 1*).

Such a constrained risk minimization is closer to reality, where banks can adjust their portfolio shares only in compliance with prudent business, than unconstrained optimization.[3] Unconstrained optimization could lead to an unrealistic portfolio share structure, as banks might not be allowed or willing to engage in it. Besides, if the prescription of unconstrained optimization was followed by the banking sector, it might lead to violation of the orthogonality between return and risk across categories of loans.

The determination of the optimal standard deviation, which we denote as $stdo_t$, is thus a solution to the following program:

$$Min_{\{\alpha_i^*\}} stdo_t = \sqrt{\sum_{i=1}^{32}\sum_{k=1}^{32} \alpha_i^* \alpha_k^* \omega_{ik}}$$

such that $\sum_{i=1}^{32} \alpha_i^* \cdot g_{it} = G_t$ and for all i it holds that $\alpha_i^* \in \{\alpha_{i,L}, \alpha_{i,H}\}$.

[2] Nevertheless, since the relative proportion of the number of observations and categories of loans is close to unity, there might be concerns about the reliability of the covariance matrix derivation. Therefore, we performed the same computations with only four aggregate categories of loans: (i) operating, export, and import loans, (ii) real estate loans, (iii) financial instrument purchase loans, (iv) consumer loans (see *Table 1*). The results of excessive risk-taking turned out to be very similar in both cases, the correlation coefficient being 0.75.

[3] The use of constraints solves the problem of the *ceteris paribus* character of the analysis where the changes to the portfolio allocations are assumed not to influence the risk-return characteristics.

Table 1 Categories of Loans

	Type of asset	Return	Risk	Average share (%)	Change in share (2005–2007)	Min./Max. share attained by an individual bank (%)	Optimal share in constrained optimization (%)
	Operating, export and import loans						
1	Loans for current assets	4.5	0.48	8.43	-2.50	5.82/22.7	7.31
2	Loans for business claims	4.8	0.34	3.47	-1.34	0.00/5.37	3.64
3	Loans for seasonal expenses	5.5	0.35	0.23	-0.12	0.09/0.63	0.23
4	Pre-export loans	3.2	0.82	0.23	0.16	0.00/0.57	0.19
5	Loans for export	2.1	0.55	0.05	-0.03	0.02/0.21	0.04
6	Loans for import and non-investment import	3.6	0.58	0.02	0.02	0.00/0.07	0.03
7	Other operating loans	5.1	0.41	1.74	-0.34	0.00/2.3	1.84
8	Loans for investment import	5.3	0.53	0.06	-0.06	0.00/0.18	0.05
	Real estate loans						
9	Residential loans for business purposes	5.8	0.38	0.49	0.15	0.00/0.71	0.53
10	Standard loans from saving-for-building-purposes	5.6	0.12	7.48	-1.77	0.00/10.98	7.99
11	Bridging loans from saving-for-building-purposes	5.8	0.39	19.58	2.54	0.00/23.86	21.27
12	Mortgage loans for residential property (without state contribution)	5.1	0.23	13.33	3.82	0.00/16.98	14.92
13	Mortgage loans for residential property (with state contribution)	5.6	0.42	3.74	-2.78	0.00/6.25	3.80
14	Mortgage loans for non-residential property	5.7	0.63	3.36	0.00	0.00/4.29	3.67
	Financial instrument purchase loans						
15	Loans for KBV	5.0	0.67	0.06	-0.01	0.00/0.14	0.07
16	Loans for purchase of securities	7.9	1.39	0.59	0.06	0.24/1.78	0.53

17	Loans for purchase of shares in business companies	5.0	0.44	0.43	-0.04	0.18/1.49	0.37
18	Loans for purchase of state shares in business companies	6.6	2.25	0.35	-0.38	0.00/1.8	0.28
19	Loans for small privatization	5.8	0.85	0.01	0.00	0.00/0.01	0.00
20	Loans for large privatization	4.8	0.65	0.35	-1.06	0.00/1.56	0.37
21	Other investment loans	5.2	0.35	12.53	0.90	10.0/28.87	11.19
	Consumer loans						
22	Consumer loans for specific goods and services	8.4	0.33	0.76	-0.26	0.51/2.02	0.66
23	Consumer loans for property	5.4	0.33	1.21	-0.04	0.00/2.21	1.58
24	Other consumer loans	6.8	0.60	0.16	0.03	0.09/0.39	0.14
25	Current-account loans and debts on current accounts	5.8	0.45	6.15	0.24	4.96/14.1	5.48
26	Subordinated loans	2.9	0.66	1.71	1.41	0.06/5.52	1.64
27	Loans from repo operations	6.9	2.18	0.54	0.10	0.03/2.11	0.57
28	Loans for temporary need of cash	3.3	0.82	0.42	-0.44	0.11/1.44	0.35
29	Other business financial loans	4.7	0.51	3.17	0.08	2.07/8.55	2.79
30	Consumer loans (without specific purpose)	9.5	0.63	7.86	0.90	5.96/18.48	7.05
31	Claims from cards	14.2	1.61	1.42	0.68	0.75/3.71	1.29
32	Other consumer financial loans	5.8	1.19	0.10	0.06	0.00/0.27	0.13

Notes: Return: average from monthly interest rate. *Risk:* standard deviation of monthly interest rate. *Average share:* average of monthly share in portfolio. *Change in share:* change in average monthly share in portfolio between 2005 and 2007 (in p.p.). Shares refer to the outstanding stocks of loans.

The excessive risk-taking by the banking sector in month t is then measured by the following ratio:

$$excessiverisk_t = \frac{stde_t - stdo_t}{stdo_t} \tag{4}$$

The excessive risk-taking thus measures the percentage reduction in the risk of the portfolio that the banking sector could have exhibited had the portfolio been efficient.

3. Data Description

We use monthly data for all banks and branches of foreign banks operating in the Czech banking market for the period from January 2005 to February 2008 from the Czech banking supervisory system. The use of an exhaustive dataset avoids any sample selection bias. We restrict our application to this period because of data availability. We need data on revenues for each category of loans to perform our analysis, and these data were available for all categories only for this period.

The banks' portfolio consists of 32 categories of loans, which represent all loans in the balance sheet of banks in the Czech banking sector. These categories can be grouped into four broad types of loans: operating, export, and import loans; real estate loans; financial instrument purchase loans; and consumer loans. The usual descriptive statistics are presented in *Table 1*.

During the sample period at our disposal (January 2005–February 2008), the Czech economy experienced its fastest-ever GDP growth, averaging 6.4% per annum. The manufacturing and construction sectors achieved the largest real revenue growth – of 10.2% and 7.2%, respectively. Unemployment dropped to 6.7% and real wages accelerated significantly, recording an average of 5.6%. Consequently, private consumption accelerated by 4.4%.

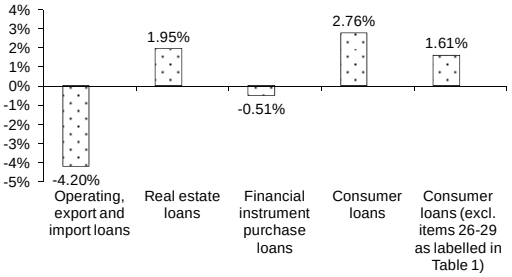
The manufacturing sector gained momentum from the transfer of new technologies, associated with a massive foreign direct investment inflow. The construction sector was also boosted to some extent by inflows of foreign direct investment and increasing demand for new housing.

Against this macroeconomic background, it is quite intuitive that the dynamics in the various types of loans mirrored the needs coming from the economy.[4] Firstly, the increasing foreign ownership in manufacturing limited the needs for operating, export, and import loans. This is due to intensifying credit lines between parent companies and their subsidiaries. Accordingly, loans in this category dropped by roughly 4% between 2005 and 2007, as can be seen in *Figure 1*.

While the portfolio share of loans for purchase of financial instruments showed only a slight reduction (0.5 p.p.), the portfolio share of consumer loans (see *Table 1* for an exact category definition) and real estate loans accelerated by roughly 3 and 2 p.p. respectively. Growth in real wages and private spending growth lies behind the rise in the portfolio share of consumer credit. Similarly, real wage growth translated into growth in the present value of an affordable mortgage and raised the de-

[4] It might be worth mentioning that the analyzed period was characterized by an economic boom phase, thus the estimated variance-covariance matrix pertains only to this period. Including a downturn or recession phase might change the optimization parameters and results.

Figure 1 Changes in Portfolio Shares Between 2005 and 2007 by Category of Loans



mand for housing. The construction sector responded to the price increase by developing more projects.

Table 1 displays the characteristics for all categories of loans. We present the average return and the average risk over the sample period. The return (average from monthly interest rate) ranges from 2.1% to 14.5% p.a., with the vast majority of loans lying between 3% and 6%. The risk (measured as the standard deviation of the monthly returns) ranges from 0.12 p.p. to 2.25 p.p., although only five categories of loans have a risk greater than 1 p.p. The computation of the coefficient of correlation between the return and the risk shows a coefficient of 0.39, which is statistically significantly positive at the 5% level. We also provide figures on the average share of each category of loans in the portfolio and the evolution of the average shares between 2005 and 2007. Three months (May for each year) were excluded from the sample due to data reporting issues.

4. Results

We provide information on the level and the evolution of excessive risk-taking by Czech banks from January 2005 to February 2008. *Table 2* summarizes the results by showing half-year averages, while *Table 3* displays the results for each month. In addition, we include the share of non-performing loans for reference purposes. *Figure 2* provides an illustration of the observations[5] and of their distance from the efficient frontier. In addition, *Table 1* shows the optimal share resulting from the constrained optimization.

Table 2 Results for Each Half-Year

Time	Return	Risk	Excessive risk-taking
1st half-year 2005	5.7150	0.1565	0.3620
2nd half-year 2005	5.7269	0.1528	0.3317
1st half-year 2006	5.7298	0.1526	0.3280
2nd half-year 2006	5.7467	0.1547	0.3417
1st half-year 2007	5.7669	0.1571	0.3560
2nd half-year 2007	5.8398	0.1555	0.3183
Average	5.7617	0.1546	0.3343

Note: The table summarizes the results by presenting the half-year averages for return, risk and excessive risk-taking.

[5] The dots in *Figure 2* represent time observations of the entire banking sector.

Figure 2 Efficient Frontier and Data

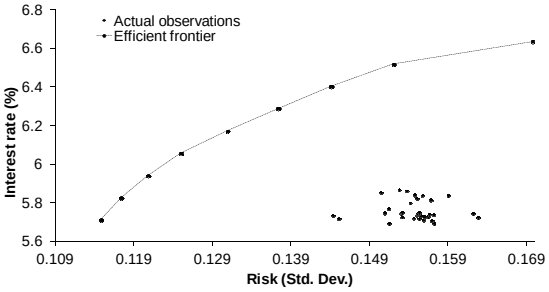
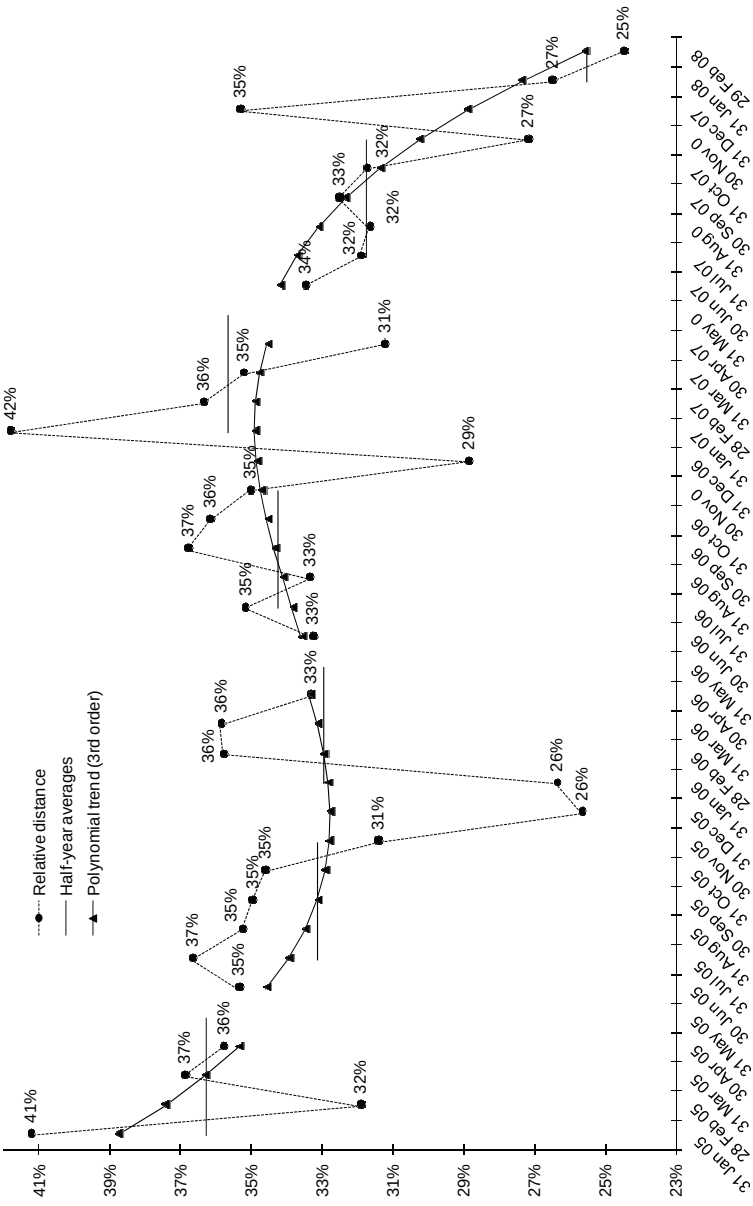


Table 3 Results for Each Month

Time	Return (%)	Risk (p.p.)	Share of non-performing loans (%)	Excessive risk-taking
31 Jan 05	5.7460	0.1622	4.86	41%
28 Feb 05	5.6942	0.1515	4.81	32%
31 Mar 05	5.6920	0.1572	4.72	37%
30 Apr 05	5.7102	0.1559	4.65	36%
30 Jun 05	5.7328	0.1555	4.47	35%
31 Jul 05	5.7063	0.1569	4.51	37%
31 Aug 05	5.7175	0.1553	4.30	35%
30 Sep 05	5.7358	0.1550	4.23	35%
31 Oct 05	5.7197	0.1546	4.14	35%
30 Nov 05	5.7477	0.1509	4.04	31%
31 Dec 05	5.7346	0.1443	4.09	26%
31 Jan 06	5.7182	0.1451	4.06	26%
28 Feb 06	5.7311	0.1559	3.94	36%
31 Mar 06	5.7246	0.1560	3.85	36%
30 Apr 06	5.7272	0.1531	3.80	33%
30 Jun 06	5.7477	0.1530	3.63	33%
31 Jul 06	5.7468	0.1552	3.78	35%
31 Aug 06	5.7513	0.1531	3.73	33%
30 Sep 06	5.7379	0.1571	3.65	37%
31 Oct 06	5.7286	0.1564	3.74	36%
30 Nov 06	5.7445	0.1551	3.66	35%
31 Dec 06	5.7710	0.1514	3.56	29%
31 Jan 07	5.7245	0.1628	3.59	42%
28 Feb 07	5.7415	0.1566	3.68	36%
31 Mar 07	5.7513	0.1553	3.48	35%
30 Apr 07	5.8002	0.1542	3.23	31%
30 Jun 07	5.8168	0.1568	3.06	34%
31 Jul 07	5.8227	0.1550	3.05	32%
31 Aug 07	5.8421	0.1547	2.98	32%
30 Sep 07	5.8365	0.1557	3.00	33%
31 Oct 07	5.8390	0.1547	2.87	32%
30 Nov 07	5.8610	0.1537	2.61	27%
31 Dec 07	5.8374	0.1590	2.64	35%
31 Jan 08	5.8676	0.1528	2.73	27%
29 Feb 08	5.8527	0.1504	2.74	25%

Figure 3 Horizontal Distance from the Efficient Frontier



Several conclusions emerge. First, the average measure of excessive risk-taking is equal to 33% over the period of study. This finding means that the Czech banking sector displays a suboptimal high risk given the level of return attained. Nevertheless, since there is no available benchmark yet (long-term average or evidence for other countries) it is difficult to judge whether it is too high or too low a number. Second, the inefficiency tended to improve (excessive risk-taking declined) over the period through changes toward a more appropriate banking sector portfolio structure. Indeed, the mean excessive risk-taking measure was equal to 36.20% for the 1st half-year 2005, but was down to 31.83% in the 2nd half-year 2007. Therefore, we clearly observe a reduction in the excess risk for the Czech banking sector, which can also be seen in *Figure 3*. Third, the analysis of return and risk over the period helps to explain this improvement. In fact, it is the result of a greater enhancement of return and slight reduction of risk for the banking sector portfolio in the boom phase of the Czech economic cycle represented in our data sample. The mean return and risk for the portfolio were 5.715 and 0.1565, respectively, for the 1st half-year 2005, and 5.8398 and 0.1555 for the 2nd half-year 2007.

In relation to the usual measure of risk taking, i.e., the share of non-performing loans, our measure of excessive risk-taking exhibits a correlation coefficient of 0.44. It might, however, be important to note that such correlation might be rather casual. During our data sample period 2005–2008, the economy operated close to or above its potential economic growth level. Such a boom phase is usually characterized by a decreasing share of non-performing loans. Nevertheless, our measure of excessive risk-taking takes account of the structural exposure to different categories of loans, and thus a decreasing share of non-performing loans during a boom phase might be common to all categories of loans. Therefore, a boom phase need not be reflected in a drop in our excessive risk-taking measure.

Conversely, a recession phase will be characterized by an elevated share of non-performing loans. However, if the increase is proportional and greater discrimination between clients according to their creditworthiness is a common feature across the categories of loans, our measure of excessive risk-taking might be relatively immune to the downturn. Nevertheless, since our sample covers a boom phase only, we cannot provide an example of the behavior of our measure of excessive risk-taking over a complete business cycle. Hence, it reflects changes in the exposure structure rather than business cycle fluctuations.

From the point of view of the constrained optimization used to derive the efficient frontier, it might be useful to assess whether and where the imposed constraints were binding.

The following optimal portfolio shares correspond to the optimization results for the return of 5.76% (the average observed return in the data sample).[6] For a more structured view, we present a comparison between unconstrained and constrained optimization for the aggregates across the four main categories of loans as distinguished in *Table 1*. While the imposed minimum share for the category of *operating, export, and import loans* was 6%[7] and the resulting optimal share was 13%, the un-

[6] It is worth mentioning that the optimal portfolio share structure differs along a different level of requested return G_j.

[7] The limit of 6% is the sum of the limits imposed on each of the sub-categories of loans. The same applies to the other three categories of loans.

constrained optimization would imply 11%. This suggests that the imposed limit was not binding within this category of loans. In the case of *real estate loans*, the specified lower bound was practically zero, while the optimal share was 52%. The share of this category in the unconstrained optimization is 77%, which exceeds the maximum exposure set in the constrained optimization by 17 p.p. and is thus a binding constraint.

Further, the 10% minimum share for *financial instrument purchase loans* was exceeded by the optimal share by 3%. Nevertheless, the unconstrained optimization would imply a 5% share. And finally, the optimal share in the constrained optimization for *consumer loans* resulted in 22%, while the preset lower bound was 15%. The unconstrained optimization would assign a share of 7% only.

It follows that unconstrained portfolio optimization implies quite a concentrated exposure to the retail sector (77%). However, such a high exposure of the entire banking sector would hardly be desirable. Thus, the constrained optimization ensures that the derived optimal shares in each category of loans do not fall below realistic shares observed in the real world.

In addition, it might also be beneficial to analyze the source of the excessive risk-taking found. We provide more insight by showing the differences in the shares of loan categories in the efficient portfolio from the actual average portfolio. In particular, in the category of *operating, export, and import loans*, the optimal share is 1 p.p. lower than that in the actual average portfolio. It follows that a reduction in lending in this category of loans would enhance risk efficiency. Similarly, reductions in the exposure to *financial instrument purchase loans* (by 1.5 p.p.) and *consumer loans* (1.8 p.p.) would lead to an overall portfolio risk reduction. And finally, an increased exposure to *real estate loans* (by 4 p.p.) would contribute to the elimination of excessive risk-taking. Overall, the downward tendency in exposure to *operating, export, and import loans* and *financial instrument purchase loans* could already be observed in the data and stands behind the improvements in excessive-risk taking. However, deepening this trend and additionally lowering the exposure to *consumer loans* while promoting *real estate lending* would eliminate the differences between the optimal and actual portfolio structures and thereby reduce the excessive-risk taking (at the particular level of return observed in the data). Nevertheless, one should keep in mind that a significant reallocation might violate an assumption of our approach, i.e., an exogenous relationship between the shares of loans in each category and the return and risk characteristics of each category of loans.

5. Conclusion

In this paper we provided a new measure of excessive risk-taking for the banking industry. This (structural) dimension might prove helpful as a complementary measure for the evaluation of banking sector stability. Our measure is based on the application of the portfolio approach to assess the risk-return combination of a banking sector's portfolio. Excessive risk-taking behavior is therefore the ratio of the optimal risk to the effective risk of the average bank portfolio for a given return at the industry level.

We compute this measure on a monthly basis for the aggregate of all Czech banks from January 2005 to February 2008. For this given period, we observe that

Czech banks have a mean excessive risk-taking measure of 33%. This means that one third of the optimal risk could be reduced while obtaining the same return. At the same time, the excessive risk-taking tended to reduce over our sample period, which means an improvement in terms of banking sector stability.

Despite the *ceteris paribus* assumption of our approach and the specific data sample covering only a boom phase of the Czech business cycle, our measure is shown to have potential value added, as it concentrates solely on structural aspects of the source of risk. It thus could serve as a complementary measure to the usual ratio of non-performing loans, which reflects the business cycle only. At the same time, it invites many extensions. It would be fruitful to perform a cross-country comparison of banking industries according to this measure. Furthermore, with a sufficient panel dataset of countries, one could also investigate the determinants of excessive risk--taking.

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